REMARKS

Claims 1-13, 22-25, 49-51 and 58 are currently pending in the Application, claims 14-21, 26-48, 52-57 and 59-63 having been withdrawn from consideration. Claims 1 and 49 are the only pending independent claims.

Of the pending claims, all stand rejected: claims 49-51 and 58 as anticipated by Armistead (5,838,759) and all other claims as unpatentable over various combinations of Armistead, Swift, Gozani, and Czirr.

IDS

A Supplementary Information Disclosure Statement (IDS) is attached hereto to remedy insufficient identification in prior disclosure with respect to two items of prior art that are submitted, along with the Supplementary IDS, for the examiner's convenience.

With respect to item AY listed in Applicant's IDS dated January 11, 2005, Applicants request acknowledgment of record to reflect that the publication date of the reference was correctly listed by Applicants as January 12, 2000.[1] Examiner, as best understood, has misinterpreted the order of date and month printed on the face of the published European application EP 0971215.

Patentability over Armistead, alone or in combination

Before addressing particular aspects of the Office Action, Applicants wish to clarify that the cited Armistead reference is concerned with the excitation, in an inspected cargo, of photoneutrons by high-energy x-rays provided by a LINAC. Two points bear pointing out at the outset:

1) In the Armistead technology, all emission (and detection) of neutrons is

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[1] The application was published 18 months after the priority date of 7/7/98, and not 29 months after the priority date, as the Examiner erroneously concluded.

essentially **contemporaneous** with the incident x-ray beam that excites them. (Decay times, while perhaps finite, are inconsequential on the time scales discussed in the Armistead patent, and there is no teaching, or suggestion, in Armistead, to perform any temporal separation of the exciting and the detected radiation.)

2) Backscatter, in the Armistead technology, is inconsequential (and, indeed, only mentioned by Armistead in the context of *not* detecting it). That is because the incident x-ray emission is of such a high energy (2-15 MeV – see Armistead, col. 2, line 44) that almost all photons burrow through the inspected material until absorbed, and few give rise to Compton scattering.

With the foregoing background in mind, it can be readily understood that the step (required by claim 49) of:

> . . . distinguishing between detected emission due to scattered penetrating radiation with the object and detected emission due to the clandestine nuclear material (step (d) of claim 49)

is completely absent from Armistead. Not only is there no explicit reference to scattering, but none can even be inferred, owing to the energy of the incident beam.

Applicants have scrutinized the text in Armistead cited by the Examiner (col. 3, lines 5-8, and col. 2, line 38-col. 3, line 8) and find no mention there, or anywhere else in Armistead, of detecting scattered penetrating radiation – but only of shielding to prevent its detection.[2] This is not surprising, because, as explained above, scattered penetrating radiation is negligible at energies employed by Armistead. Since there is no mention of detecting scattered penetrating radiation in Armistead, there can be no "distinguishing" of scattered penetrating radiation, as required by claim 49, nor, for that matter, is there any motivation for Armistead to distinguish scattered radiation that

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[2] For completeness, the cited language of Armistead, col. 2, line 38 – col. 3, line 8, is reproduced on a sheet appended to this Response, to make abundantly clear that there is no teaching or hint of a suggestion dealing in any way with detection of scattered penetrating radiation.

is not detected. Indeed, of the six occurrences in Armistead of words based on the root "scatter," only one occurrence has to do at all with scattered x-ray radiation, and that is at col. 4, line 61, where it is taught that the detectors are shielded from X rays.[3] The other references to scattering have to do with physical mechanisms for thermalizing neutrons within the cargo and with an optical encoder for correcting image data for motion-induced irregularities. None of these bear on the claimed distinction between detected emission due to scattered illuminating radiation and emission arising indigenously from the inspected object.

The foregoing discussion thus provides one, very fundamental reason, that Armistead cannot anticipate claim 49, or any of the pending claims (50, 51 and 58) that depend from claim 49.[4]

Claim 49, and claims 50, 51 and 58 are not, therefore, anticipated by Armistead, whose technique of photoneutron generation is entirely inapposite to the claimed invention, and withdrawal of that rejection is respectfully requested.

The rejection of claims 1 and 22-24 over a combination of Armistead and Swift is traversed for reasons essentially analogous to those discussed above with respect to the method claims: Armistead nowhere teaches or suggests element (b) of claim 1: a detector configured to detect penetrating radiation backscattered by the object. Swift does teach detection of backscattered radiation, however the combination with Armistead is anathema to Armistead who teaches that detection of scattered incident radiation is to be *avoided* by shielding. (See Armistead, col. 4, lines 56 *ff.*)

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[3] There are exactly six occurrences of the words "scatter, " "scattered," or "scattering" in the Armistead patent. These are at col. 3; lines 11 and 28; col. 4, line 61; col. 5, lines 52 and 62; and col. 9, line 64.

[4] It might be helpful to point out that any distinction based on timing in Armistead, to which the Office Action refers in the third paragraph of page 4, is a distinction between one position and another. The incident beam and the detected photoneutrons in Armistead are still essentially contemporaneous, as far as any individual position is concerned.

Therefore, a processor configured as a detector signal discriminator between scattered incident radiation and radiation of an indigenous origin (as required by element (c) of claim 1) cannot be suggested by any combination of Armistead with Swift for the plain reason that Armistead eschews and teaches away from any detection of scattered radiation.[5]

For these reasons, since Armistead fails to teach the detection of backscattered radiation and cannot be combined with any reference that does, claim 1, and all pending claims dependent therefrom, are deemed to be patentable over Armistead, taken alone or in combination with any other art of record.

Patentability over Gozani in combination with other cited references

Gozani is cited as a primary obviousness reference for rejection of claims 1-11, 13 and 25 in combination with various other references.

Gozani teaches irradiating an object with fast neutrons that excite characteristic gamma-ray fluorescence lines, which are detected and analyzed. At the same time, Gozani has a parallel x-ray system that performs conventional x-ray transmission imaging (like a dental, or other skeletal, x-ray) in order to simultaneously determine the electron density of the neutron-induced-fluorescence-interrogated material.

In Gozani, the x-ray transmission imaging and neutron activation are two disjoint probe modalities, each of which is based on illuminating an object with external particles.

Consideration of Gozani, taken alone in the first instance, is invited, in order to ascertain what limitations of the instant claimed invention are missing and would need to be provided by other references, in order for there to be even a *prima facie* showing of obviousness. Gozani, as acknowledged in the Office Action, p. 6, lacks the claimed

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[5] The Armistead passage cited at the foot of page 8 of the Office Action, col. 5 (as best understood), lines 41-59, deals with scattering in the context of scattering photoneutrons, as they travel through the cargo, thereby thermalizing the high-kinetic-energy neutrons that are photogenerated by >2 MeV X-rays. This has nothing whatsoever to do with detection of the radiation that illuminates the cargo.

detector of backscattered penetrating radiation, and therefore has no need for, and does not suggest, a processor configured to generate an output indicating whether the detector signal is triggered by an origin other than backscattered penetrating radiation.

Swift, of course, *does* teach detection of backscattered penetrating radiation, and the advantages, 1-3, of backscatter imaging enumerated in the Office Action at p. 6 are acknowledged.

That said, the claimed invention is neither the overlay of neutron-activated gamma-ray fluorescence spectroscopy with x-ray backscatter imaging that would result from the combination of references invoked in the Office Action, nor is it suggested by such an overlay.

In particular, use of a single detector to detect scattered particles from the illuminating beam and other particles that arise spontaneously from within the interrogated object is nowhere taught or suggested by Gozani, alone or in combination with Swift, and cannot be read back into those references in light of the teachings of the present invention. Moreover, the neutron detector of Gozani, to which the Office Action refers in discussion of claim 7 on page 7, does not detect neutrons arising indigenously in the inspected material but rather simply monitors transmission through the object of illuminating fast neutrons to derive nuclear density, again, merely another imaging modality.

Moreover, the present invention does not claim merely gated illumination and detection (as introduced in the additional limitation of claim 9), but teaches detection during the "off" period of the source, thereby giving rise to the requirement, in claim 1, of a processor configured as a detector signal discriminator, a feature neither taught nor suggested by any combination of references.

Therefore, claim 1, and all the claims dependent therefrom, are deemed allowable over Gozani taken in combination with all other references of record (Annis, Czirr, and Resnick, more particularly), none of which teach or suggest discrimination, in a single apparatus, between the triggering of a detector (that also detects backscattered illuminating radiation) by an origin other than penetrating radiation backscattered by the object.

Reconsideration of the pending claims in light of the foregoing discussion, and their allowance, are now respectfully requested.

Respectfully submitted,

Date: August 3, 2006

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01945/00A47 495127.1

Appendix

Language cited in the Office Action in regard to the claimed proposition of distinguishing scattered penetrating radiation from detected emission due to clandestine nuclear material:

> The above objective has been met with a cargo inspection system which uses a single beam for a unique combination of X-ray inspection and neutron-induced gamma-ray spectroscopy employing a "photoneutron probe". The X-ray inspection system uses a commercial linear accelerator X-ray source; a variety are [sic] available with peak accelerating energies from 2 MV to 15 MV. The X rays are emitted in a continuous string of pulses. Such X-ray sources are reasonably compact and inexpensive compared to accelerator-type neutron sources. For probing suspicious masses or areas of vehicles and containers detected in the X-ray image, the same X-ray beam source is temporarily converted to a pulsed source of neutrons by inserting a beryllium (Be) sheet, i.e., a beam converter, in the X-ray beam. The interaction of X rays with the Be converter can generate photoneutrons. The difference between the parent X-ray energy and the photoneutron reaction threshold energy is available to the neutron as kinetic energy. The neutron yield cross-sections for photoneutron interactions are well documented.
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> In this invention, the inspection process is a two-tiered approach. First, the contents of a vehicle or container are inspected using X-ray imaging in a scanning mode. If nothing unusual is detected, the object is cleared. However, if suspicious shapes, densities or compartments are revealed, the X-ray source would temporarily be converted into a neutron source using a Be converter to produce a pulsed beam of photoneutrons targeted on designated suspicious areas. Contraband, if present, would absorb thermalized neutrons and emit gamma rays (or, in the case of special nuclear materials, fission neutrons) characteristic of the material of interest. A threat is revealed if gamma rays characteristic of nitrogen, in the case of many explosives and "fertilizer bombs," or chlorine, in the case of certain drugs such as heroin and cocaine typically smuggled as chlorides, are detected. Likewise, special nuclear materials (e.g., uranium and plutonium) can be detected by fission neutrons produced by capture of the photoneutrons.
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> (Armistead, US Patent No. 5,838,759, col. 2, line 38 – col. 3, line 8)